

May 31, 1997

Progress Report
submitted to the Office of International Health Programs (EH-63)
Department of Energy

Title of project: I-129 Dosimetry

PI: Tore Straume

Period covered in this report: 1/1/97 to 5/31/97

I. Summary of Work

The purpose of this work is to create a map for the country of Belarus containing the deposition of radioiodine from the Chernobyl accident and also the concentration of total iodine in soil in these territories. Specifically, the map will contain the measured deposition densities of ^{129}I , the inferred deposition densities of ^{131}I , and the concentration of total iodine of soil.

The work will be accomplished by working closely with collaborators in Minsk and Munich.

II. Milestones and Deliverables Accomplished During the Reporting Period

- a) Joint Agreement for the Study: Participants of the study in Belarus, Germany, and the United States developed a joint agreement during the past several months. The agreement was signed by all parties in Minsk on May 27, 1997 (a copy of the agreement is enclosed).
- b) Collection of Soil Samples in Belarus: The collection of soil samples has been planned for several months and began on May 28, 1997, and should be completed in mid June. The sampling locations and protocols were selected to complement previous sampling locations made in 1993 by Drs. Straume and Anspaugh et al., and in 1994 and 1995 by scientists in Munich, Germany (a map of the sampling locations is enclosed). The measurement methods of ^{129}I and total iodine by the different laboratories will be intercalibrated so that all data can be used to maximize information and reduce costs for any single lab. The University of Utah provided \$6000 and GSF (Munich) provided \$5000 to pay for the field expedition and associated costs in Belarus.
- c) Training for a Minsk Chemist at the University of Utah: Training on how to extract iodine from soil samples is required for the Minsk laboratory. A chemist has now been selected in Minsk and the date for travel to Utah will be sometime in July/August 1997. The chemist will receive training in our Utah laboratory for about two months.
- d) Equipment for the Minsk Laboratory: The Minsk laboratory must be supplied with the essential equipment so that they can reliably extract iodine from soil. We have identified the equipment required (a list of equipment is enclosed). Purchase orders will be placed for the required equipment during June/July 1997, with expected delivery during August/September 1997.

III. Other Relevant Information

Relocation from Livermore to Utah: As expected, the relocation of laboratories and offices from LLNL to the University of Utah has impacted our work. Without such interruption it was expected that the training of the Minsk chemist in the extraction and measurement of iodine would have commenced in March/April. Instead, the training is now expected to take place in the July/August time period. However, the milestones that are independent of the laboratory have progressed as expected, i.e., the development of the sampling protocols, the joint agreement, and the sampling expedition.

During the first five months, as with the Hiroshima Dosimetry project, the costs have been lower than expected because the laboratory has not been functional and there has been an expected time period required to replace personnel (postdoc and lab tech). The lab costs will increase during the remainder of the FY as a postdoc and lab tech are hired and as associated laboratory supplies and expenses increase.

Because of the tight budget in FY97, it was not possible to purchase a gas chromatograph (GC) for the Minsk laboratory. In fact, as you recall, DOE was not able to provide a GC for our laboratory in Utah---fortunately, we were able to borrow the one we had from Livermore. It may be that a small table-top GC will be required for the Minsk laboratory so that they can measure total iodine in the soil extracts, needed for quality control of their extraction method. We are also exploring a less costly method, i.e., the use of a spectrophotometer which apparently exists in Minsk. We should know during the next month or so whether the spectrophotometer method will be adequate. If not, the cost of a CG would be in the \$20,000 range.

IV. Publications and Preprints

T. Straume, A.A. Marchetti, L.R. Anspaugh, et al., "The feasibility of using ^{129}I to reconstruct ^{131}I deposition from the Chernobyl reactor accident," Health Phys., 71 (1996) 733.

A.A. Marchetti, F. Gu, T. Straume, "Determination of total iodine and sample preparation for AMS measurement of ^{129}I in environmental matrices," presented at the 7th International Conference on Accelerator Mass Spectrometry, Nucl. Instr. Meth. B, 123 (1997) 352.

F. Gu, A.A. Marchetti, T. Straume, "Determination of iodine in milk and oyster tissue samples using combustion and peroxydisulfate oxidation," The Analyst, (in press).

T. Straume, presentation at "Workshop for Dose Reconstruction in Chernobyl Sasakawa Project" at the Hiroshima University, Hiroshima, Japan (March 28, 1997).

AGREEMENT

about conducting of research

DETERMINATION OF ^{129}I AND TOTAL IODINE CONTENTS IN SOIL OF THE TERRITORY OF BELARUS AFTER THE CHERNOBYL ACCIDENT

1. GENERAL PROVISIONS

The subject of the present Agreement is the coordination and carrying out of investigations stimulated by the "*Belarussian-American Scientific Protocol on Study of Thyroid Cancer and other Thyroid Diseases in Belarus after the Chernobyl Accident*", the "*American-Belarussian-Russian-German Study to Determine the Feasibility of Using ^{129}I to Infer ^{131}I Deposition from the Chernobyl Accident*", and the "*Belarussian-German Scientific project: Wissenschaftler helfen Tschernobyl Kindern*".

The purposes of the present Agreement are:

- definition of the participants of the study, Determination of ^{129}I and Total Iodine Contents in Soil of the Territory of Belarus after the Chernobyl Accident;
- assignment of responsibilities of the participants;
- establishment of interaction among the participants;
- definition of funding sources and procedure for data exchange; and
- general definition of presentation of results of the research, e.g., one or more peer-reviewed publications.

2. BACKGROUND

Radioiodine released into the atmosphere from the Chernobyl accident has resulted in large-scale exposure to the population of Belarus. To study the medical consequences of the Chernobyl accident, the long-term epidemiological *Belorussian-American Scientific Protocol on Study of Thyroid Cancer and other Thyroid Diseases in Belarus after the Chernobyl Accident* (further the Protocol) is being carried out. While only dosimetry for this study has begun in earnest, it is already clear from other data that many children in Belarus and Ukraine have already suffered from the occurrence of thyroid cancer. In fact, this may be the major long-term detectable oncogenic effect of the Chernobyl accident. In the context of a Belarussian-German project, *Wissenschaftler helfen Tschernobyl Kindern*, children with thyroid cancer are receiving post-operative radioiodine therapy in Essen/Würzburg. Also, children not treated surgically receive radioiodine therapy at the Center for Thyroid Cancer. The accuracy of the thyroid doses for these children may be substantially improved by the ^{129}I technique, which is being evaluated and improved as a result of the present agreement. The assessment of individual thyroid doses based on direct ^{131}I thyroidal content measurements and on results of personal interview about the residence, migration and lifestyle during iodine-deposition periods is the subjects of the Protocol. Data about ^{131}I -deposition density at the locations of interest would be helpful for correct interpretation of results of direct measurements and for estimations of thyroid doses. For locations where direct measurement were not made in a timely fashion, e.g., the Brest Oblast, inference of the ^{131}I -deposition density is the only possible means of dose reconstruction. Unfortunately, for the majority of territories of Belarus the information on results of direct measurements of ^{131}I activity concentration in soil and vegetation in the first two months are absent. It now appears that the best possible way to reconstruct ^{131}I -deposition density many years after the accident is the measurement of long-lived ^{129}I concentration

in soil and the constant ratio between ^{131}I and ^{129}I . Therefore, a study to determine the ^{129}I contents in soil of the whole territory of Belarus is envisaged. Because of the interest in concentrations of stable iodine as well (some regions of Belarus may be deficient in iodine), and because stable iodine is usually measured as part of the procedure to extract and measure ^{129}I , total iodine concentrations will also be measured in all of the soil samples.

3. PURPOSE AND GOALS OF THE RESEARCH

The purposes of the Research is to obtain data on ^{129}I contents in soil and total iodine in soil from measurements of samples to be taken on the territory of Belarus.

The goals and timetable of the Research are indicated in the Table:

Time-Table of Research

Work contents	1997											1998										
	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Preparation of the Agreement																						
Selection of settlements for field expedition																						
Development of method for soil sampling																						
Conducting of field expedition																						
Study of technique of iodine extraction from soil																						
Soil samples processing																						
γ -spectrometry of soil samples																						
Iodine extraction from soil samples																						
Analysis of extracts by AMS to measure ^{129}I																						
Analysis of the results of measurements																						
Preparation of ^{131}I deposition map verified on the basis of the Research results																						
Preparation of joint publications																						
Preparation of recommendations on using the Research results																						

4. PARTICIPANTS

The administrative management of the Research on the territory of Belarus is to be carried out by the Ministry of Health of Belarus. Address: Miasnikova St., 39, Minsk, 220048, Belarus.

The participants of Research are the following organizations:

1. Belorussian Research Sanitary and Hygiene Institute of the Ministry of Health of Belarus. Address: F.Skoriny St., 8, Minsk, 220012, Belarus.
2. Center of the Radiation Control and Monitoring of Natural Environment of the State Committee on Hydrometeorology of Belarus. Address: F. Skoriny Ave., 110^a, Minsk, 220023, Belarus.
3. University of Utah, Division of Radiobiology, Department of Pharmacology and Toxicology, Salt Lake City, UT 84112, USA.
4. GSF-Institute of Radiation Protection, Section Riskanalysis. Address: Ingolstädter Landstraße 1, D-85764 Neuherberg, Germany.

5. RESPONSIBILITIES OF THE PARTICIPANTS

The present Agreement establishes the following responsibilities of the participants of the Research:

Ministry of Health of the Republic of Belarus:

1. Administrative support of Research.
2. Preparation at national level of the documents, necessary for successful fulfillment of Research.
3. Organization of invitations to Belarus for the foreign participants of Research.

Belorussian Research Institute of Radiation Medicine:

1. Coordination with the participants of the list of settlements to be sampled during the field expedition.
2. Installation of gamma-spectrometry and radiochemical equipment.
3. Obtain capability for iodine extraction from soil, including training in USA.
4. Organization of field expedition.
5. Taking of soil samples on the sites.
6. Exposure rate and field gamma spectrometry measurements at the selected sampling sites.
7. Processing of soil samples and preparation for measurements.
8. Gamma-spectrometry measurements of soil samples.
9. Providing identical soil samples for intercalibration of the iodine-extraction technique among University of Utah, GSF, and Belarus (10 samples from the samples collected during the May/June 1997 mission).
10. Iodine extraction from soil samples.
11. Transfer extracts to the University of Utah from all of the soil samples for total iodine and ¹²⁹I measurement.
12. Preparation of report about the field expedition.

Center of the Radiation Control and Monitoring of Natural Environment:

1. Selecting of the settlements for the field expedition together with Research Sanitary and Hygiene Institute, University of Utah, and GSF.
2. Providing ^{137,134}Cs-deposition values for the selected locations to all participants.
3. Selecting of sites for soil sampling within the settlements.
4. Taking of soil samples on the sites.
5. Registration of the passports on soil samples.
6. Measuring of exposure rate at the sites.
7. Coordination of the results of exposure-rate and gamma-spectrometry measurements.
8. Preparation of ¹³¹I deposition map, as verified based on the results of ¹²⁹I measurements.

University of Utah:

1. Purchase and delivery of the equipment to Belarus for iodine extraction from the soil.

2. Training of one chemist from Belarus in the technique of iodine extraction from soil.
3. Participation in the field expedition.
4. Quality control of iodine extraction from soil.
5. Measuring of total iodine and ^{129}I in extracts from soil, and in 10 soil samples from the 1997 sampling mission.

Section Riskanalysis GSF-Institute of Radiation Protection:

1. Providing of vehicles for two teams for the field expedition.
2. Participation in the field expedition.
3. In cooperation with Minsk and the University of Utah, measure total iodine and ^{129}I in the 10 soil samples used for intercalibration and quality control.

For all participants of Research:

1. Coordination of the procedure for taking of soil samples.
2. Discussion of results of all measurements.
3. Discussion of prepared ^{131}I deposition map verified based on the results of ^{129}I measurements.
4. Discussion of prepared total iodine concentration map.
5. Preparation of joint publications.
6. Preparation of scientific recommendations.

6. DATA EXCHANGE AND REPORTING RESULTS

The present Agreement establishes the following data exchange among the participants of Research:

Belarussian Research Sanitary and Hygiene Institute:

1. Transfers to the Center of the Radiation Control and Monitoring of Natural Environment for coordination the results of on-site exposure-rate measurements, field gamma spectrometry measurements, and gamma-spectrometry measurements of soil samples in the laboratory.
2. Distributes among all participants the results of all measurements.
3. Report to the Ministry of Health on the results of the field expedition.
4. Intercalibration of iodine extraction technique with soil samples.

Center of the Radiation Control and Monitoring of Natural Environment:

1. Transfers to the Belarussian Research Sanitary and Hygiene Institute after coordination the results of on-site exposure-rate measurements, field gamma spectrometry measurements, and gamma-spectrometry measurements of soil samples in the laboratory.
2. Distributes among all participants results of all measurements.
3. Distributes among all participants prepared ^{131}I deposition map verified on the basis of the ^{129}I measurements results and a total iodine concentration map based on total iodine measured in the soil samples.

University of Utah:

1. Distributes among all participants results of total iodine and ^{129}I measurements.
2. In collaboration with Minsk and GSF, data will also be provided from the intercalibration measurements.

Section Riskanalysis GSF-Institute of Radiation Protection:

1. Distributes among all participants results of field gamma spectrometry data measured on the sites.

2. Provide data from the intercalibration study on 10 samples, including iodine extraction, total iodine measurement, and ^{129}I measurement.

7. FUNDING

The present Agreement establishes the following sources of funding of the Research.

Ministry of Health of the Republic of Belarus:

- Expenses for preparation of working rooms for the equipment, necessary for fulfillment of the Research;
- Expenses for metrological certification of the equipment, necessary for realization of research (gamma-spectrometry, laboratory balances, etc.);
- Custom taxes for the equipment.

Belorussian Research Sanitary and Hygiene Institute:

- Overhead charges for operation of working rooms and equipment, necessary for fulfillment of research;
- Cost of materials and reagents necessary for gamma-spectrometry measurements and radiochemical iodine extraction.

Center of the Radiation Control and Monitoring of Natural Environment:

- Transport expenses.

University of Utah:

- Charges for purchase and delivery of the equipment for iodine extraction;
- Expenses for training of one chemist from Belarus in the technique of iodine extraction from soil;
- Charges for purchase and delivery of the equipment for iodine extraction;
- Partial support for the field expedition and related work in Belarus;
- The expenses related to the total iodine and ^{129}I measurements made by the University of Utah;
- The costs of joint publications.

GSF-Institute of Radiation Protection, Section Riskanalysis:

- Part of the expenses caused by conduction of the field expedition.
- The expenses related to the total iodine and ^{129}I measurements made by GSF on 10 samples.

8. AGREEMENT VALIDITY

The present Agreement shall enter into force after signature by all participants of Research.

The present Agreement shall terminate on 31 December 1998. If the participants agree, the closing date can be changed. US funding for this project is currently scheduled to terminate on 1 July 1998.

9. ADDITIONAL CONDITIONS

The technical details of fulfillment of the Research will be developed by the participants during a month after signing the Agreement and will be distributed among the partners.

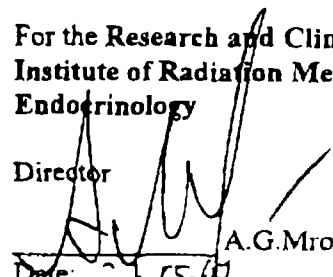
**For the Ministry of Health
of the Republic of Belarus**

Head of the Chernobyl Department

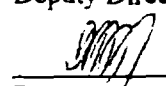
 V.A. Stezhko
Date: 27.05.97

**For the Research and Clinical
Institute of Radiation Medicine and
Endocrinology**


Director

 A.G. Mrochek, Prof., M.D.
Date: 27.05.97

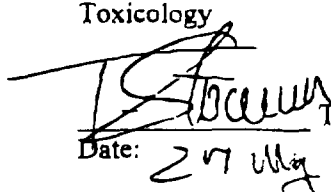
Deputy Director

 Ya.I. Kenigsberg, Prof., M.D.
Date: 27.05.97

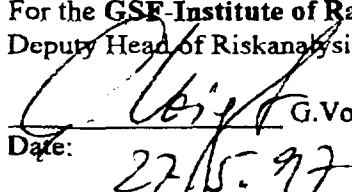
**For the Republican Center of the
Radiation Control and Monitoring of
Natural Environment**
Head

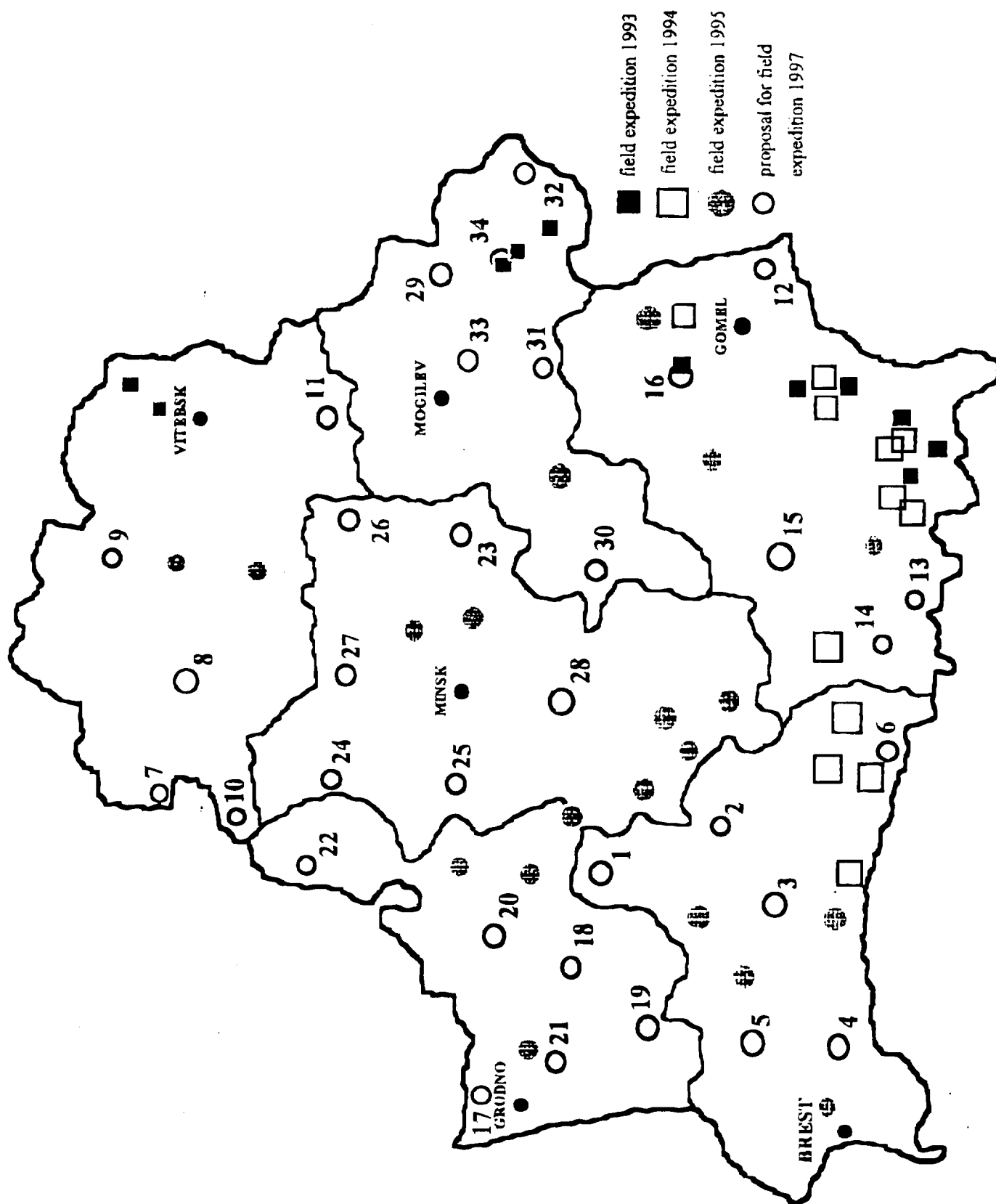
 I.I. Matveenko
Date: 27.05.97

**For the University of Utah
Department of Pharmacology and
Toxicology**

 T. Straume, Prof., Ph.D.
Date: 27 May 1997

For the GSF-Institute of Radiation Protection
Deputy Head of Riskanalysis

 G. Voigt, Ph.D.
Date: 27.05.97



Equipment required in Minsk for the extraction of iodine from soil.

Quantity	Description
1	A supply of oxygen gas, i.e., oxygen tank with regulator and flow meter (operational flow ~80 ml/min)
2	Tube furnace with temperature control range to 1100 °C
2	Auxiliary furnace with temperature control range to ~1000°C
2	Quartz tubes, ~2.5 cm diam with tapered connections to connect to oxygen supply on c end and to iodine trap bottle on the other end
supply	Quartz wool (coarse) for placing inside the end of the quartz tube
2	Iodine trap bottle with tapered joint connection
1	Analytical balance
2 or more	Combustion boats, quartz or porcelain
supply	Analytical reagents (KOH, Na ₂ SO ₃)
supply	Double distilled water
supply	Volumetric flasks, 100 ml
1	Gas chromatograph, or perhaps a spectrophotometer may work. We'll evaluate.

Office of International Health Programs (EH-63) Funded Projects/U.S. Department of Energy

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*Preliens - orders placed, but not yet paid for
 ** unobligated \$\$ available
 As of 4/30/97